INTEREST RATE PASS-THROUGH EFFECT USING VECM: EVIDENCE FROM PAKISTAN

Farhan Ahmed[1], Kalsoom Ali[2] and Muhammad Kashif[3]

Abstract

This research paper examines empirically the interest rate pass-through for Pakistan. Using treasury bills rate (proxy for policy rate), weighted average lending rate (WALR), weighted average deposit rate (WADR), to represent networks of lending and deposit rate - six-month call money rate (CMR) and CPI are tested from 2006 – 2015 on monthly frequency. Vector error correction model (VECM) has been applied after checking the stationarity in the series following variance decomposition, impulse response function and Wald test. In Pakistan, the impact of pass-through on call money rate and CPI has been resulted only in short run while in the long run, the impact of pass-through has been resulted on all the exogenous variables in the system.

Keywords: Monetary Policy, Call Money Rate, Lending, Deposit Rates, Pakistan.

JEL Classification: M290

Introduction

Background/preamble

The innovation in interest rate is important from a price and financial stability viewpoint. The traditional view is that, the cost of capital is influenced due to change in real policy rate that in turns affects investment and consumption to the extent which in turn also affect the prices and level of income earned (Mishkin, 1995). Recently, almost all-central banks directed monetary policy through market-orientated tools in the manufacturing countries has devised to influence short-range interest rates (Borio, 1997). Central banks have more dominant role in money market interest rates and financial market conditions; thereby interest rate money market is set. Market rates with longer time periods and banks' interest rate policy get affected due to variation in policy rates in varying degrees. Banking prudential regulation policy and their decisions has great impact on the behavior of

[1] Department of Economics & Management Science, NED University of Engineering & Technology, Karachi, Pakistan. Email: farhan.mba2013@gmail.com
[2] ANZ Bank, Australia. Email: kalsoomali2008@gmail.com
[3] Department of Management Sciences, SZABIST, Karachi, Pakistan. Email: muhammad.kashif@szabist.edu.pk

consumers whether corporate or general consumers when they are interested in making returns on assets and liabilities of the banks.

In this changing world and globalization scenario, understanding of monetary transmission is the basis of modern monetary policymaking- a mechanism that allows the central bank to move the economy in desired and set directions and transmits the policy to real sectors. The usefulness of monetary policy is determined through the speed and potency of the transmission mechanism. The mechanism is complex, however, and with different shapes or degree depends on the factors such as macroeconomic conditions, financial market assembly and growth, governing agenda and worldwide impacts of crisis.

The interest rate channel is the most traditional mechanism among the various channels of monetary transmission and has been exposed to intense analysis and high attention. The attention to monetary mechanism gets its pick when CPI was considered in a monetary policy framework for which the interest is the main pillar. It is important for head of the banks, CPI targeted to know the extent of changes in policy rates affect CPI over a certain period of time. According to the Taylor principle, to stabilize CPI, a central bank should increase its interest rate more than one-to-one with increases in CPI (Benigno & Woodford, 2003). For effective monetary policy, it is essential that alteration in the authorized interest rate (official interest rate) be transferred to other rates quickly and the amount of the change on to other rates is large enough to influence aggregate demand at least to certain level (Kim & Lim, 2001). Thus, it is worth to describe the extent of interest rate impulse in order to establish the efficacy of the economic policy transmission mechanism. The importance of monetary policy transmission mechanism and the curiosity of policymakers have resulted into many theoretical studies over the past decades to reveal its properties and to understand its functions. It is necessary that financial sectors should have know-how about the nature of policy rate because it directly determines the sustainability of the system working and formulating the rates (Aydin, 2007; Hofmann et al., 2006). Furthermore, the banks' prices sets influence their margins, cost-effectiveness. There was rapid interest rate adjustment development in the USA banking sector, dedicated to the degree of interest rates adhesiveness and their unevenness (Hannan & Berger, 1991, Neumark & Sharpe, 1992). Observed outcomes are as follows, of one is that there is partial response to interest rates i.e., the policy rate is partially pass-through to retail rates and other interest rates. Second, pass-through differs considerably within and outside the country. Third, interest rates pass-through differ subject to the type of interest rate used according to the state's general practice and literature. Lastly, researchers that consider asymmetry adjustments found asymmetric sign, which mainly differs across region. Reasons for the extent of fluctuations of pass-through and asymmetric pass-through across globe and includes over the period if the policy era is moderate, rigid with strict compliance of the regulations (Egert, et al., 2007), the chapter of financial market progress (Cottarelli & Kourelis, 1994; Borio & Fritz, 1995; Weth, 2002), the parallel of financial market directness, the focus within the banking sector, lop-sided information exchanging cost, bank size (Hannan & Berger, 1991).

Fluctuation and changes in oil prices affects reserves and balance of payment of country, which passes the impulse to currency rate and interest rate shocks. In a decade the oil prices have shown many fluctuations from high to low with much influence on economic indicators rates such as CPI etc. For controlling the situation, central bank goes for forming different policies. Therefore, the (SBP) operationally, influences the treasury bills rate (proxy to interest rate) on the assumption that the shocks in it bring changeability in all other charges and rates with different effectiveness. The cost of capital and thus level of investment and consumption in the economy is persuaded due to alteration in these rates. Prior justification of the monetary transmission machinery makes it clear then it becomes difficult, to use the passages that involve interest rate to affect level of output and so, for the SBP when the benefit in the basic rate is not transferred to other distinctive rates. Hence it is vital to trial whether the changes in the treasury bills rates are dispatched on WALR, WADR and CMR, to other rates and if yes at what speed and to what extent. This study answers the following questions.

- What is the extent of IRPT in Pakistan?
- What is the degree of pass-through from the money market or the policy rate to the deposit and lending rates,
- What is the speed of pass through to different rates of call money rates and CPI rates?
- Are variables such as lending rates, deposit rates, call money rates and CPI rates impact the treasury bills rate?

The main objective of the base paper is to understand the central banks' interest rate policy with innovation in rate. The focus of this topic is an important part of the monetary transmission mechanism that is the deviation in bank charges with respect to money rates. The study tackles the questions of the magnitude of pass-through, or there is fully pass-through or not when the study is under consideration, the reasons of lesser impulses and if there is unevenness or irregularity in the nature of shock of treasury bills rate. The result is that the reaction of innovation from the treasury bills rate to financing and credit rate are much less in the shock period that is the lending and deposit rate shows much stringency (Cottarelli & Kourelis, 1994; Hanan & Berger, 1991). For upward and downward policy rate, the nature of pass-on is not normal or equal (Hanan & Berger, 1991). The studies have shown that for three months the market rates is not reflected entirely in the bank's financing rates but the case is reverse over the long tenor with higher blows. They were the first to study the model of autoregressive distributed lag to see the changes of market rate to the change in advancing rates in different countries (Cottarelli & Kourelis, 1994; Fritz, 1995). Also the short-term slowness is found in short-term bank lending rates to enterprises, but assumes a priori a complete long-term pass-through (Heinemann & Schuller, 2003). All of the reports indicates that the shocks for the long-term bank lending rates is less complete than for lending to enterprises for short term period (Heinemann & Schuller, 2003). The main message is that the deposit rate changes are due to minor costs. The variation in security rates result a change in the deposit rates only if the costs involved in changing the payments rate is less than the revenue involved. Thus main findings are; impulse differs directly with the depositors' base and inversely with degree of market concentration. These findings

are attributed to banks' ability to employ market power in the deposit market. Different analysis is conducted in that era which comes with the view that regulation and rates tremor differ across European (Mojon, 2000). The main outcomes of the analysis are: pass-through is lower from money market rates to credit rates due to volatility of money market rates while the situation is reverse in case of CPI. Banks are also involved in speeding up the rates due to increase competition. There are various studies that support the inflexibility of bank rates on treasury bills rate is listed (Mojon, 2000). First, the borrower pays more with increase in bank standing rates. The increase in lending rates affects the credit ability of customers as the burden is transferred to them that reduce their ability to pay the loan. Second while resetting retail rates even small menu costs incurred could lead to price rigidity. Third, still bank provides clear rate guarantee by not revising the rate in despite change in money market rate. That's why; long-term relationship investment is preferred by bank. Fourth, the problem with mismatch in maturity exists with lower pass-through for longer rates and higher pass-through for short-term rates. Finally, perhaps there would be ambiguity about future due to the volatility of the money market rates. With every time changes in rates, the banks suffer with costs at the time of rates adjustments. This will result in delaying the lending rates by bankers until the banker adjusts the money market rates. Different sources and factors add to the costs, which makes the bank to clarify the rigidity of the rates (Nabar et al., 1993):

The pass-through is examined in the retail banking markets of euro-zone area and found that with predicted monetary shocks the loan rates response is speedy (Kleimeier & Sander, 2006). Overall, this study agrees that degree of short-run bank interest rate stickiness is a considerable. There is incomplete pass-through to call money rate in Asian countries (Wang & Lee, 2009). In 1991 with the introduction of the market based monetary management in Pakistan the treasury bills have been increasingly used as a tool of monetary policy. The greater degree of pass-through and short duration results in output of monetary policy and price level. It is vital to see the changes in rates with respect to Pakistan.

For this study purpose the model used is vector error correction model (VECM) and the equation for general vector error correction model with deterministic trend is taken from the

$$\Delta \boldsymbol{Yt} = \emptyset + \prod \boldsymbol{Yt} - \boldsymbol{1} + \propto \boldsymbol{t} + \sum_{i=1}^{p-1} \gamma \boldsymbol{i} \Delta \boldsymbol{Yt} - \boldsymbol{i} + \in \boldsymbol{t} \quad \text{.....(1)}$$

This can be rewritten for test equation as:

$$\Delta \boldsymbol{Yt} = \boldsymbol{\phi 1} + \propto \boldsymbol{1}\ \boldsymbol{t} + \boldsymbol{\gamma}(\boldsymbol{\beta}' \boldsymbol{Yt} - \boldsymbol{1} - \boldsymbol{\phi 2} - \boldsymbol{\alpha 2 t}) + \sum_{i=1}^{p-1} \gamma \boldsymbol{i} \Delta \boldsymbol{Yt} - \boldsymbol{i} + \in \boldsymbol{t} \quad \text{.....(2)}$$

Where $\phi = \phi 1 - \gamma \phi 2$ and $\alpha = \alpha 1 - \gamma \alpha$

The intuition of this expression is that a change in can come from the time trend, or the error correction part of the expression (the error correction part is the only in parenthesis). The last part of the expression with a summation from i=1 up to p-1 of lagged values of the differenced dependent variable is used to eliminate serial correlation.

Research Data & Empirical Analysis

High frequency monthly data has been collected from Statistics & Warehouse department of State Bank of Pakistan for the measurement of pass-through. The variables are monthly treasury bills rate, deposit rates; lending rates (disbursement), call money rate and CPI rate etc. Weighted average lending and deposit rates (marginal) are used for simpler lending and deposit rates required for the analysis. The sample period is from January 2006 to December 2015 as per the availability of the data. For the analysis of this study, monthly data is taken into consideration of treasury bills rate (proxy of interest rate) on weighted average lending rate, weighted average deposit rates, call money rate and CPI rate, variables, from Pakistan's central bank and commercial banks perspective. Descriptive statistics of the individual variables are observed through running regression to see if the data is statistically acceptable or normal. The basic model used is VECM (vector error correction Model). The unit root test is run to see if the data is stationary or non-stationary to check the random walk behavior. Granger causality test is also applied to see the join effect of independent (lag) variables on dependent variable as drawn from the VECM model, to check the significance of variables.

Descriptive Statistics

Table 1
Descriptive Statistics

Var:	Min	Max	Mean	Median	SD	Kurtosis	Skewness	JB. P value
TB	6.3	14.01	10.45	9.98	2.05	2.01	0.02	.08
CMR	6.45	16.04	10.97	10.14	2.15	2.64	0.13	0.59
CPI	1.30	25.33	10.26	9.02	5.23	4.07	0.98	.000
WADR	2.94	7.86	5.68	5.65	1.10	2.14	-0.08	0.14
WALR	7.98	15.01	11.86	11.12	1.72	2.05	-0.08	.096

The descriptive statistics summarizes the analysis that helps to better understand the figures or numbers. Table 1 shows the description of each variable to see the minimum, maximum values, standard deviations, and kurtosis and probability value of Jarque-Bera if the variables are significant enough to run the model directly with Pakistan's perspective. The minimum rates for Treasury bill is 6.3, with high value of 14.01 and mean value of 10.45. The dispersion value is 2.05 that are more from the mean value of discount rate. Kurtosis channels the top or peak to check the normality distribution of the variable. The TB kurtosis is less than value 3, so the nature is flat (platykurtic). Skewness is measure of the disparity and irregularity. The value 0.028 indicates the positive skewness, having right tail. While the JB P-value shows that the data is normal as its value is more than 5%.

Analyzing CMR, the high and low values lie in 16.04 and 6.45 with average value of 10.97 and median value of 10.14 with dispersion value of 2.15 from its mean value. The nature of graph is level (platykurtic) and skewness with positive value of right-tailed. The probability value interprets that the variable is normal as p-value is more than 5%.

Similarly, CPI has an average value of 10.26 with leptokurtic behaviour and positive skewed value with less probability value than 5%, showing non-normality.

Further, the averages of WADR and WALR are 5.68 and 11.86 with a skewed value of negative tailed and (platykurtic) behaviour with probability values more than 5%, indicating normality of the data.

Table 2
Unit Root Test (Random Walk Test)

Variables	Order of Integration	ADF Test	Null Hypothesis
CMR	I(0)	0.7551	Not rejected.
	I(1)	0.00	**Rejected**.
TB	I(0)	0.84	Not rejected.
	I(1)	0.00	**Rejected**.
CPI	I(0)	0.82	Not rejected.
	I(1)	0.00	**Rejected**.
WDAR	I(0)	0.24	Not rejected.
	I(1)	0.00	**Rejected**.
WALR	I(0)	0.74	Not rejected.
	I(1)	0.02	**Rejected**.

Lag Selection Criteria

Lag length selection is a trade-off the curse of dimensionality and reduced models, which are not appropriate to specify the active adjustments. The literature reviews suggest that the lag length should be twelve (12) for monthly time series data. There are many criteria, which is used to go for the lag selection such as Akaike information criterion, Schwarz information criterion and Hannan-Quinn information criterion. With lag length to be short, the error terms autocorrelation leads

to significant and inefficient estimators resulting in wrong results.

Table 3
Lag selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
1	-204.02	78.8	5.47e-05	4.37	5.12	**4.67***
2	-169.26	62.38	4.57e-05	4.19	5.56	4.74
3	-139.50	50.62	**4.21e-05***	4.10	6.10	4.91
4	-115.66	38.31	4.37e-05	4.12	6.74	5.18
5	-101.10	22.04	5.43e-05	4.31	7.56	5.63
6	-79.95	30.04	6.05e-05	4.39	8.26	5.96
7	-49.04	41.01	5.70e-05	4.28	8.77	6.10
8	-18.15	38.10	5.48e-05	4.17	9.29	6.24
9	13.62	36.23	5.29e-05	4.04	9.78	6.37
10	38.16	25.68	6.03e-05	4.05	10.42	6.63
11	55.70	16.72	8.10e-05	4.19	11.18	7.02
12	101.31	**39.22***	6.73e-05	**3.80***	11.42	6.89

The lower the value of lag the better is the model so AIC has low value of lag at 12 so twelve lag is taken as shown in the table below for further running the models.

Johansen Cointegration Test

JJohansen first ran Johansson cointegration in 1988, having desirable properties, including the fact that all variables are tested as endogenous variables and to eliminate serial correlation with desired number of lags. In this test, a set of variables is defined as cointegrated if a linear combination of them is stationary. The precondition for the variables to be cointegrated is that they should be non-stationary at level while stationary at first difference. A cointegrating relationship may also be seen possible that variables may deviate from their relationship in short run but with long-run association over the period. If there were no cointegration among the variables, there would be no long-run relationship binding the series. For testing the co-integration we will see the unrestricted trace test and maximum Eigenvalue test to check is there any cointegration or not among the variables under observation by running Johansson cointegration test.
H0: There is no cointegration among variables
H1: There is cointegration among variables.

Table 4
Johansson Cointegration Test

Trace or Rank test				
# of cointegration	Trace statistics	0.05 Critical Value	Prob**	Null Hypothesis
None *	101.6574	69.81	0.00	Rejected.
At most 1 *	56.05295	47.85	0.00	Rejected.
At most 2	22.69128	29.79	0.26	Not rejected.
Maximum Eigenvalue test				
# of cointegration	Max-Eigen Statistics	0.05 Critical Value	Prob**	Null Hypothesis
None *	45.60449	33.87687	0.0013	Rejected.
At most 1 *	33.36167	27.58434	0.0081	Rejected.
At most 2	15.07836	21.13162	0.2835	Not rejected.

There is long-run relationship or association ship between the variables or the variables move together as the variables are cointegrated as trace test indicates 2 cointegrated equations at the 0.05 levels. Similarly the maximum Eigenvalue also indicates the same level of cointegration among variables over the long period. We accept the null hypothesis at 2 cointegrated levels and reject the null hypothesis at level of none and first level, as critical value is less than the max-eigenvalue statistics or p-value is less than 5%.

Vector Error Correction Model (VECM)

After applying the Johansen cointegration test for the variables not being stationary at level but stationary at first difference, the existence of co-integration gives inside to go for the vector error correction model. For the whole system, one cointegrated equation is undertaken. VECM is a system equation, means variables can be solved simultaneously. In the VECM model, the lag values of variables explains the dependent variables in VEC model but it can be best explain with the help of p-value and is significant if it is less than 5%.

The cointegrating equation part represents the long-run equilibrium relation. The equation developed is; DTB (-1)+0.028902-3.535318 * DWADR (-1)-2.568446 * DWALR (-1)+2.277913 *DCPI (-1). While the error correction part represents the short run relations.

Impulse Response Function

Impulse function is developed to see the shock of variables to other variables over a period of time. It explains the function to see the response of variables (its lag values) to main variables. The impulse response function indicates that the six months treasury bills rate pass-through has negative effect on DWADR at the initial period of two, while it is raising and declining with positive and negative impact over other period in the long run. Response of DWADR to TB is positive over the long period with high trend at initial periods but a little decline in the period end. Response of DWALR is also positive and high over the short period with minor decline in the long run but responds over all the periods. DCMR response to DTB is highly positive at initial period with fluctuations onwards in the long run period. Response of DCPI to DTB is negative in the short run but increased very minute over the long run means there is response to the periods overall.

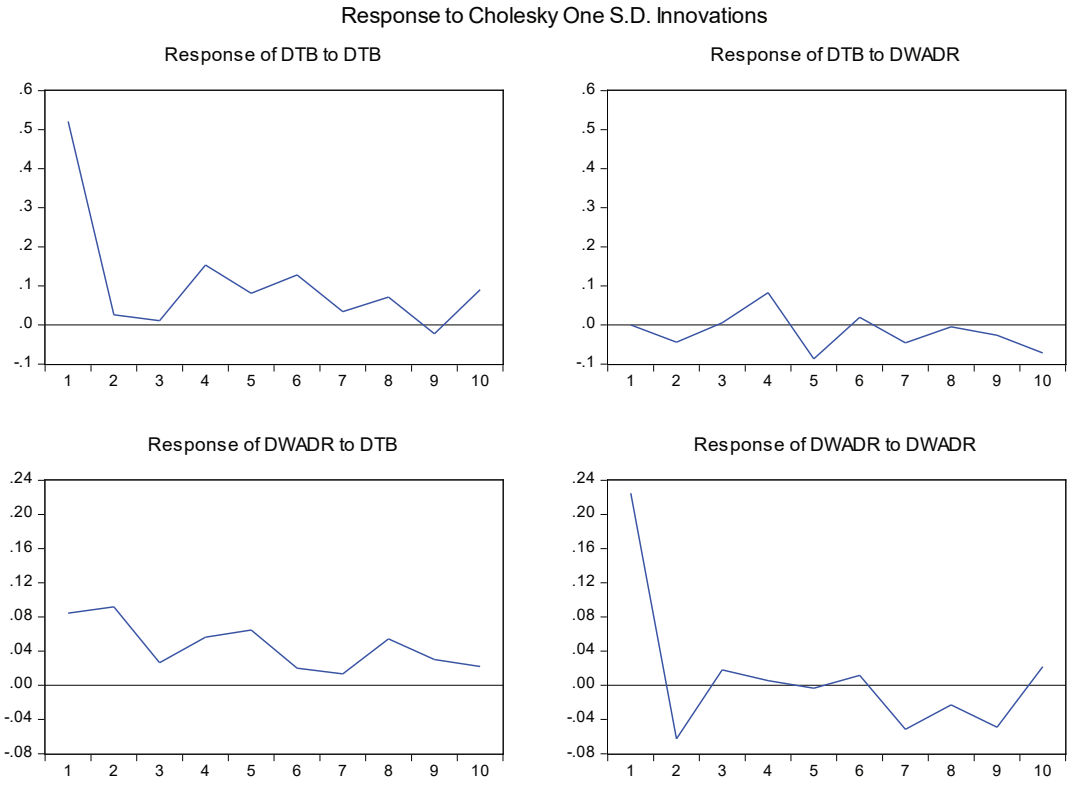

Figure 1: Response to Cholesky One S.D. Innovations

Variance Decomposition function

Variance decomposition explains the percentage shock of one variable to other variables (Hamilton, 1994). In the short run period of three, the innovation or shock to DTB is 74.1955 percent, variation of fluctuations in the DTB (own shock), impulse in DCMR (call money rate) can cause 1.263621 percent fluctuation in DTB (treasury bills rate). The shock in DWALR (weighted average lending rate) can cause 11.9253 percent change in DTB (Treasury bill rate). The shock in DWADR is 0.99094 percent variation in DTB, which is very minute variation. In the long run, the shock to DTB (own) shock can contribute 53.13 percent to DTB, which is great variation of own shock. The shock/innovation to DCMR can contribute 9.75 percent fluctuations in the variance of DTB, which is great variance from short run. Also the impulse in DWALR is 11.42 percent, contributing variance in

DTB, which is slight variation from short time period. The innovation in DWADR contributes 9.09 percent fluctuations in DDR in the period 10, which is high change from period three. The contribution of WALR is almost same which means the story remains unchanged while WADR and CMR causes a fluctuation in the long run. Statistically, it can be said that in Pakistan, the impact of pass-through on call money rate and CPI has been resulted only in short run while in the long run, the impact of pass-through on has been resulted on all the exogenous variables in the system.

VAR Granger Causality/ Block Erogeneity Wald Tests

Granger causality tests examine if the variables lagged value helps to predict the dependent variables or to check the independent variable can cause the dependent variable. Tests of these forms were described by Granger (1969) and a slight variant due to Sims (1972). However, finding the causality doesn't mean that variations or shocks in one variables result in variation to other variables. It implies the sequential arrangement of movements in the time series.

Table 5
Wald Test (DTB as Dependent Variable)

Series	Joint Level of Significance (lag values) 5%	Null Hypothesis
DCPI	0.23	Rejected.
DWDAR	0.02	Not rejected.
DWALR	0.08	Not rejected.
DCMR	0.09	Not rejected.

H0: DWADR, DWALR, DCMR, DCPI cannot cause the DTB.
H1: DWADR, DWALR, DCMR, DCPI can cause DTB.

Taking the DTB as dependent variable and others as independent variables, joint values of DCMR and DWADR, DWALR helps to forecast the DTB at the significance level of 5% and 10% as the probability values are 0.0988, 0.0274 and 0.0884, so accepting the alternate assumptions and getting the null hypothesis to be rejected for the variables DWADR, DCMR, DWALR While the DCPI is more than the desired critical value so we accept the null hypothesis for CPI. From the Granger casualty test, the joint values (all lag values) of call money rate, weighted average lending rate and weighted average deposit rate helps to forecast the treasury bills rate at significance level while CPI has no significant contribution to TB or CPI and TB are independent of each other. Further we can also go for interpreting by taking the DCPI, DWADR and DWALR as dependent and see the other independent variables cause on the endogenous variables respectively. The pass-through from treasury bills rate to CPI exhibit rigidity or no significant cause in the period of impacts or shocks.

Conclusion & Recommendations

Pakistan is an emerging economy and on the way towards development and effective changes. The influence of its policies and monetary transmission mechanism set out the rates for the whole economy to run in the best possible way. The important variables, which are to be decided and studied thoroughly by central bank and help in deciding the rates to be imposed to run the monetary mechanism, are lending rates and deposit rates (the main rates), call money rates and CPI in response to change in six months treasury bills rate (proxy to interest rate in case of Pakistan). The study went through examining the impulse and cointegration on all variables. The results show that there is significant pass through from six months treasury bills rate to call money rate and weighted average lending and deposit rate in Pakistan. However, the pass through is insignificant for CPI rate means this variable does not cause the treasury bills rate (proxy to policy rate, a change than pass literature or researches conducted). In real the pass-through is sharp and quicker from initial periods to end periods in case of findings for CMR and WADR with slight or same pass through in the short and the long run. Further researches can be conducted by taking the treasury bills rate as dependent variable as a proxy to see the influence, cointegration or interdependencies to other influential rates in the running economy with increased number of observations from authentic sources. This paper can provide knowledge or basis for treasury bills rate pass-through to economic indicators to further the research process. The result from this research will help to widen the horizon by considering the treasury bills rate as effective variable with respect to other variables by taking the costs and fluctuations in policies under considerations.

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